

REMARKS

The Examiner's final Office Action of July 2, 2003 has been received and its contents reviewed. Applicants would like to thank the Examiner for the consideration given the above-identified application.

Claims 1-14 are pending for consideration in the present application, of which claims 1-3 and 13-14 are independent.

Referring now to the detailed Office Action, claims 1-3, 6-8, and 11 stand rejected under 35 U.S.C. §103(a) as unpatentable over Silver (U.S. Patent No. 5,104,818) in view of Yamazaki (U.S. Patent No. 4,727,044 – hereafter Yamazaki). Further, claims 4-5 stand rejected under 35 U.S.C. §103(a) as unpatentable over Silver in view of Yamazaki, and further in view of Zhang et al. (U.S. Patent No. 5,904,509 – hereafter Zhang). Still further, claims 9-10 and 12-14 stand rejected under 35 U.S.C. §103(a) as unpatentable over Silver in view of Yamazaki, and further in view of Miyasaka (U.S. Patent No. 6,455,360). These rejections are respectfully traversed at least for the reasons provided below.

Claim 1 of the present invention is directed to a method of manufacturing a semiconductor device comprising the step of ion-doping an impurity element into a channel region, wherein said impurity element imparts n-type conductivity or p-type conductivity to said semiconductor film, wherein a concentration of said impurity element is in the range from 1×10^{15} to 5×10^{17} atoms/cm³ in said semiconductor film after the ion-doping step, and wherein a concentration of carbon is at 3×10^{17} atoms/cm³ or less in said semiconductor film after the step of ion-doping.

Independent claim 2 parallels claim 1 and recites a concentration of nitride at 1×10^{17} atoms/cm³ or less in the semiconductor film after the step of ion-doping.

Independent claim 3 parallels claim 1 and recites a concentration of oxygen at 3×10^{17} atoms/cm³ or less in the semiconductor film after the step of ion-doping.

Independent claim 13 parallels claim 1 and recites a concentration of hydrogen at 1×10^{19} atoms/cm³ or less in the semiconductor film after the step of ion-doping.

Claim 14 parallels claim 1 and recites a source material gas containing said impurity element diluted with hydrogen to the concentration in the range from 0.5% to 5, i.e., 0.5-5% diborane.

As disclosed in page 3, line 7 through page 5, line 9 of the specification, Applicants recognized a problem wherein ambient atmospheric components, such as nitrogen, oxygen, carbon and hydrogen, are also added when ion-doping an impurity element into a channel region, and the added ambient atmospheric components may cause the TFT characteristics to be varied. Hence, Applicants devised a method for solving the problem of undesirably adding nitrogen, oxygen, carbon and hydrogen. To solve the problem, the concentration ratio of the impurity element with respect to hydrogen is increased (in particular, a source material gas including the impurity element diluted with hydrogen to the concentration range from 0.5% to 5%), thereby resulting in reduction in the concentration of the ambient atmospheric components.

Applicants respectfully submit that neither Silver nor Yamazaki recognizes the problem in which ambient atmospheric components, such as nitrogen, oxygen, carbon and hydrogen, are also added when ion-doping an impurity element into a channel region, and in which the added ambient atmospheric components may cause the TFT characteristics to be varied.

Further, neither Silver nor Yamazaki discloses or suggests a method of diluting source material gas including the impurity element with hydrogen to the concentration range from 0.5% to 5%.

In the rejection of independent claims 1-3, the Examiner acknowledges that Silver fails to disclose the concentration of C, O, and N of less than 3×10^{17} atoms/cm³. To cure this deficiency of Silver, the Examiner applies Yamazaki, asserting that it would be obvious to combine Yamazaki with Silver, as Yamazaki discloses forming a semiconductor film so that O, C, and N concentration in the film are all less than 5×10^{18} atoms/cm³. In response to the Examiner's assertion, Applicants respectfully submit that without disclosure or suggestion by Silver or Yamazaki of the problem the presently claimed invention is solving, there is no motivation to combine Silver and Yamazaki.

Applicants respectfully submit that, even if Yamazaki '044 were combined with Silver, their combination would not render a concentration of carbon of 3×10^{17} atoms/cm³ or less, a concentration of nitrogen is a 1×10^{17} atoms/cm³ or less, a concentration of oxygen is at 3×10^{17} atoms/cm³ or less obvious.

It is well settled that when combining the references in order to support a *prima facie* case of obviousness, the references must be considered in their entirety. It is further settled that the mere fact that the prior art may be modified to reflect features of the claimed invention does not make the modification and hence the claimed invention obvious unless the desirability of such modification is suggested by the prior art itself. Moreover, the claimed invention cannot be used as an instruction manual or “template” to piece together the teachings of the prior art so that the claimed invention is rendered obvious, *In Re Fritsch*, 23 USPQ2d 1780 (Fed. Cir. 1992). Additionally, the statements and facts at issue set forth in a reference leading one of ordinary skill in the art away from the proposed modification must also be fully considered when combining references in order to support a *prima facie* case of obviousness.

Moreover, the requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the reference themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations.

With respect to Miyasaka, Examiner asserts that the reference discloses performing a doping step using diborane diluted with hydrogen at a concentration of 0.1% to 10%. Hence, the Examiner concludes that would be obvious to combine Miyasaka with Silver and Yamazaki to cure the deficiency of an impurity element imparting p-type conductivity conducted with a gas of diborane dilute with hydrogen from 0.5% to either 1 or 5%. However, Applicants recognize that a dilution concentration 0.5% to 5% (preferably, 0.5% to 1%) is suitable because a larger amount of hydrogen atoms is added when a dilution concentration is 0.1%, and a period of time to be required for process is significantly reduced to 16 second, which makes it difficult to control the apparatus when a dilution concentration is 5%, as disclosed in, e.g., page 13, line 8 through page 14, line 7 of the specification. Therefore, Applicants respectfully submit that Miyasaka does not recognize the reason of the dilution concentration 0.5% to 5%, and hence it would not be obvious to modify the disclosed

range of 0.1% to 10% of Miyasaka and to combine its teaching with Silver and Yamazaki to make Applicants' claimed invention.

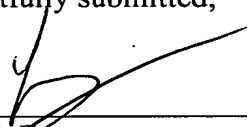
Further, as submitted in the Amendment filed January 10, 2003, Miyasaka does not recognize the problem of the ambient atmospheric components (C, N, O) in the TFT characteristics because 0.1-10% diborane disclosed by Miyasaka includes unsuitable range for the purpose of the present invention.

In view of the arguments set forth above, Applicants respectfully request reconsideration and withdrawal of all pending §103(a) rejections.

Conclusion

Having responded to all rejections set forth in the outstanding Office Action, it is submitted that the claims are now in condition for allowance. An early and favorable Notice of Allowance is respectfully solicited. In the event that the Examiner is of the opinion that a brief telephone or personal interview will facilitate allowance of one or more of the above claims, the Examiner is courteously requested to contact Applicants' undersigned representative.

Respectfully submitted,



Luan C. Do
Registration No. 38,434

JLC/LCD
NIXON PEABODY LLP
Suite 900, 401 9th Street, N.W.
Washington, D.C. 20004-2128
(202) 585-8000